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ABSTRACT

This guide explains how employers can support math and science achievement in U.S. schools. Section 1 reports data from Third International Mathematics and Science Study regarding the math and science achievement of students in grades 4, 8, and 12 worldwide. Section 2 establishes a link between academic achievement and workplace success through workplace examples of the application of basic academic knowledge and higher-order thinking skills. Discussed in section 3 are six ways for businesses to support increased math and science achievement: articulate workplace academic skill requirements and ensure their incorporation into academic standards; support more rigorous teaching training incorporating mastery of content and its application to success in the workplace; support programs that expose students to the world of work; support the use of clear, reliable, and broadly disseminated student and system performance data; use student achievement in hiring decisions; and encourage employees to increase their involvement with local schools. Section 4 poses 6 questions that business leaders can use to engage parents, employers, educators, colleges, and community members in efforts to improve math and science achievement, and section 5 contains an annotated bibliography of 17 resource organizations that can help employers support student achievement. Thirty-eight endnotes are listed. (MN)

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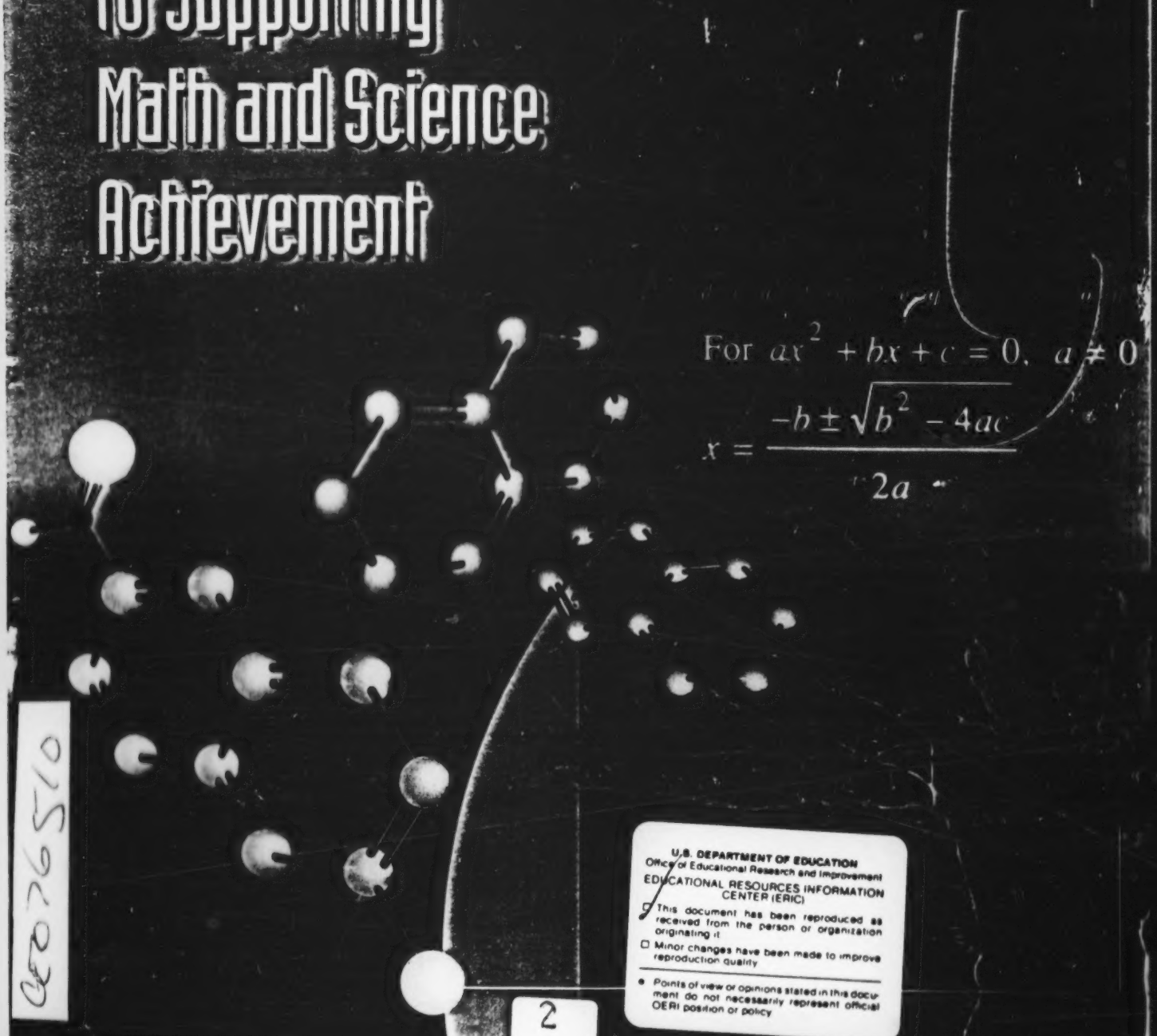
ED 419 914

The Formula for Success:

A Business Leader's Guide to Supporting Math and Science Achievement



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Business Coalition for Education Reform

BCER

May 1998

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U.S. Department of Education
Richard W. Riley
Secretary

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EXECUTIVE SUMMARY

"From the perspective of having enough skilled employees tomorrow, math and science education is the key to our future."[1]

Laurie Sachtleben
Chevron, Inc.

"Almost two-thirds of students surveyed in a recent study readily admit that they could do much better in school if they tried"[2]

Getting By: What American Teenagers Really Think About Their Schools
Report from Public Agenda—1997

THE PURPOSES OF THIS GUIDE ARE AS FOLLOWS:

(1) to provide the business community with vital 4th-, 8th-, and 12th-grade TIMSS data on math and science achievement of America's students;

(2) to make the link between academic achievement and workplace success by offering workplace examples of the application of both basic academic knowledge and higher order thinking skills;

(3) to provide examples of business roles to support increased math and science achievement;

(4) to pose questions that business leaders can use to begin or continue conversations with other stakeholders—parents, educators, students, policymakers—about efforts to improve math and science achievement in their community; and

(5) to outline resources that can assist employers in supporting student achievement.

As the juxtaposition of these two quotations illustrates, many of our students today do not see a compelling reason to put forth the required effort necessary to excel in school, and yet, academic performance is more important than ever to individual and societal success. Indeed, almost every job today increasingly demands a combination of theoretical knowledge and skills that require learning throughout a lifetime.

Individuals need the academic knowledge and skills that equip them to succeed in today's ever-changing economy. It should come as no surprise then, that almost 90 percent of new jobs require more than a high school level of literacy and math skills.[3] Today, when even a small firm may compete head-to-head with suppliers in Budapest and Osaka, the demand for productivity grows greater by the day. Management theorist Peter Drucker's belief that "knowledge has become the key resource"[4] is borne out by a torrent of evidence that the knowledge content of work is increasing, and that education is the key to maintaining a competitive edge.

Economic journalist Robert J. Samuelson elaborates, "Schools are one foundation of the economy. If students leave with poor skills, there are consequences. One is waste. Giving people a third or fourth chance (whether in college or on the job) is expensive. Some people learn skills later that they could have learned earlier. Some skills are never learned. One result is a scarcity of high-skilled workers; another is many low-skilled workers trapped in poverty or semi-permanent unemployment."[5] The corollary to this statement is that everyone in society benefits when student achievement in primary and secondary school increases.

Results from the recent Third International Math and Science Study (TIMSS), which compared performance in mathematics and science of a half-million students worldwide at three age ranges corresponding roughly to grades 4, 8, and 12, including 33,000 Americans, reinforces in stark terms the need for all stakeholders in our education system to join together to boost student performance across the board. While U.S. students at the fourth-grade level were near the first in the world in science, and were above the international average in mathematics, by the eighth grade, U.S. performance had fallen to slightly above the international average in science and to below the international average in mathematics.

STRATEGIES FOR EMPLOYERS TO SUPPORT MATH AND SCIENCE ACHIEVEMENT

(1) Articulate workplace academic skill requirements; communicate these needs to schools, parents, and students on a regular basis; and ensure these skills are incorporated into academic standards.

(2) Support more rigorous teacher training that incorporates mastery of content as well as its application to success in the workplace.

(3) Support programs that expose students to the world of work.

(4) Support the use of student and system performance data that are clear, reliable, and broadly disseminated.

(5) Use student achievement in hiring decisions to send the message to all students that academic achievement is important.

(6) Encourage employees, especially those who are parents, and other community stakeholders to increase their involvement with local schools to help students achieve challenging academic standards.

Analyses of eighth-grade teaching and curriculum show our country has a fragmented curriculum and teaching generally is not focused on challenging content nor is it executed in a way that promotes problem-solving skills. The majority of our students do not take advanced math or science courses, do not have a solid foundation coming out of middle school, and are not being taught by teachers fully prepared to teach math and science. As a result, by the 12th-grade, U.S. ranking fell to below average in both science and mathematics, even among our advanced students.

The message of TIMSS is that we still have a long way to go to ensure that all children achieve to world-class standards. In many states, standards lack the academic rigor necessary to be competitive with standards throughout the world. And in other cases, standards exist in name only, having not yet been linked with assessments, professional development, curricula, and the day-to-day operations of the classroom. Until this changes, our students will continue to remain far from our national goal of being first in the world in math and science.

Business knows that American students are not leaving school with the skills they need to be successful. Jobs that require strong academic skills are vacant due to a lack of qualified workers and remedial training costs are rising. The point is to do something about it—for the sake of our students, our businesses, and our country's future.

Employers and educators are working together to address the challenges which are made so apparent by TIMSS. Section three offers strategies that the business community is using (1) to ensure students and teachers understand the value of math and science mastery to success in the workplace, and (2) to support management and capacity issues to build school districts and buildings into continuously improving systems. The efforts highlighted in *The Formula for Success: A Business Leader's Guide to Supporting Math and Science Achievement* offer models for business and education leaders to learn from as they develop strategies in their own communities to support math and science achievement.

For American students to be "first in the world," these types of efforts must be expanded so that every student understands the importance of mastering challenging mathematical and scientific concepts and has the opportunity to be part of an education system which is aligned to support the achievement of these high academic standards. A recent article in the *Christian Science Monitor* reinforces the importance of employers and educators working together to raise math and science achievement in the following way: "Not all graduates are slated to become engineers, rocket scientists, and software writers. But any major nation needs business leaders, shop foremen and women, farmers, legislators, savvy consumers, and voters who think logically and critically about their professions and the issues facing family, community, and the nation."[6]

Section One

WHAT HAPPENED TO "FIRST IN THE WORLD"?

FOURTH-GRADE ACHIEVEMENT RESULTS (26 NATIONS)

"U.S. students score **above the international average** in mathematics, outperformed by only seven countries."

"U.S. students score **near first in the world** in science, outperformed only by Korea."

EIGHTH-GRADE ACHIEVEMENT RESULTS (41 NATIONS)

"U.S. students score **below the international average** in mathematics."

"U.S. students score **slightly above the international average** in science."

TWELFTH-GRADE ACHIEVEMENT RESULTS *

ACHIEVEMENT OF ALL STUDENTS (21 NATIONS)

"U.S. 12th-graders scored **below the international average** and among the lowest of the 21 participating nations in both mathematics and science general knowledge. The United States outperformed only South Africa and Cyprus on both assessments."

ACHIEVEMENT OF ADVANCED STUDENTS (16 NATIONS)

"The performance of U.S. physics and advanced mathematics students was **below the international average** and among the lowest of the 16 countries that administered the physics and math assessments. The United States outperformed no other country on either assessment."

ACHIEVEMENT OF AP CALCULUS STUDENTS (16 NATIONS)

"When U.S. 12th-graders with Advanced Placement calculus instruction (about 5 percent of the United States cohort) are compared to all advanced mathematics students in other nations, their performance is **at the international average** and significantly higher than five other countries."

ACHIEVEMENT OF AP PHYSICS STUDENTS (16 NATIONS)

"When U.S. 12th-graders with Advanced Placement physics instruction (about 1 percent of the United States cohort) are compared to all advanced science students in other nations, their performance was **below the international average** and significantly higher than only one other country."[7]

* Asian countries, many of which outperformed the United States in fourth- and eighth-grade results, did not participate in the twelfth-grade study.

"By the year 2000, United States students will be first in the world in mathematics and science achievement."

National Education Goal #5

That is where we stand, 8 years after the President and the nation's governors declared our national intention to be "first in the world" in math and science by the year 2000. According to TIMSS, the Third International Mathematics and Science Study, our performance in these two critical subjects is far from this goal.

"First in the world" is not an empty slogan. It is the level of performance needed to maintain American preeminence in an internationally competitive economy—and to make sure jobs do not migrate to countries with stronger skills. It is the level of achievement necessary to ensure that Americans have the skills necessary to succeed in an ever-changing workplace. And it is the level of achievement necessary to ensure that Americans maintain a high quality of life.

Is TIMSS merely one more set of numbers? Not by a long shot. It provides not only achievement results but also rich new context about how nations educate their children.

OVERVIEW OF TIMSS RESULTS

FOURTH GRADE SCIENCE

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
Korea	597

Nations With Average Scores Not Significantly Different From The U.S.

Nations	Average
Japan	574
United States	565
(Austria)	565
(Australia)	562
(Netherlands)	557
Czech Republic	557

Nations With Average Scores Significantly Lower Than The U.S.

Nations	Average
England *▲	551
Canada	549
Singapore	547
(Slovenia)	546
Ireland	539
Scotland▲	536
Hong Kong	533
(Hungary)	532
New Zealand	531
Norway	530
(Latvia (LSS))	512
(Israel)	505
Iceland	505
Greece	497
Portugal	480
Cyprus	475
(Thailand)	473
Iran, Islamic Republic	416
(Kuwait)	401

International Average = 524◆

Source: Martin et al. (1996) Science Achievement in the Primary School Years. Table 1.1. Boston College: Chestnut Hill, MA.

FOURTH GRADE MATHEMATICS

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
Singapore	625
Korea	611
Japan	597
Hong Kong	587
(Netherlands)	577
Czech Republic	567
(Austria)	559

Nations With Average Scores not Significantly Different from The U.S.

Nation	Average
(Slovenia)	552
Ireland	550
(Hungary)	548
(Australia)	546
United States	545
Canada	532
(Israel)	531

Nations With Average Scores Significantly Lower Than The U.S.

Nation	Average
(Latvia (LSS))	525
Scotland▲	520
England*▲	513
Cyprus	502
Norway	502
New Zealand	499
Greece	492
(Thailand)	490
Portugal	475
Iceland	474
Iran, Islamic Republic	429
(Kuwait)	400

International Average = 529◆

Source: Mullis et al. (1996) Mathematics Achievement in the Primary School Years - Table 1.1. Boston College: Chestnut Hill, MA.

EIGHTH GRADE SCIENCE

Nations With Average Scores Significantly Higher Than The U.S.

Nations	Average
Singapore	607
Czech Republic	574
Japan	571
Korea	565
(Bulgaria)	565
(Netherlands)	560
(Slovenia)	560
(Austria)	558
Hungary	554

Nations With Average Scores Not Significantly Different From The U.S.

Nation	Average
England*▲	552
Belgium-Flemish▲	550
(Australia)	545
Slovak Republic	544
Russian Federation	538
Ireland	538
Sweden	535
United States▲	534
(Germany)*▲	531
Canada	531
Norway	527
New Zealand	525
(Thailand)	525
(Israel)*	524
Hong Kong	522
Switzerland▲	522
(Scotland)●	517

Nations With Average Scores Significantly Lower Than The U.S.

Nations	Average
Spain●	517
France	498
(Greece)	497
Iceland	494
(Romania)	486
Latvia (LSS)▲	485
Portugal	480
(Denmark)	478
Lithuania*	476
(Belgium-French)	471
Iran, Islamic Republic	470
Cyprus	463
(Kuwait)	430
(Colombia)	411
(South Africa)	326

International Average = 516★

Source: Beaton et al. (1996) Science Achievement in the Middle School Years. Table 1.1. Boston College: Chestnut Hill, MA.

EIGHTH GRADE MATHEMATICS

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
Singapore	643
Korea	607
Japan	605
Hong Kong	588
Belgium-Flemish▲	565
Czech Republic	564
Slovak Republic	547
Switzerland▲	545
(Netherlands)	541
(Slovenia)	541
(Bulgaria)	540
(Austria)	539
France	538
Hungary	537
Russian Federation	535
(Australia)	530
Ireland	527
Canada	527
(Belgium-French)	526
Sweden■	519

Nations With Average Scores Not Significantly Different From The U.S.

Nation	Average
(Thailand)	522
(Israel) *	522
(Germany) *	509
New Zealand	508
England*▲	506
Norway	503
(Denmark)	502
United States▲	500
(Scotland)	498
Latvia(LSS)▲	493
Spain	487
Iceland	487
(Greece)	484
(Romania)	482

Nations With Average Scores Significantly Lower Than The U.S.

Nation	Average
Lithuania*	477
Cyprus	474
Portugal	454
Iran, Islamic Republic	428
(Kuwait)	392
(Colombia)	385
(South Africa)	354

International Average = 513★

Source: Beaton et al. (1996) Mathematics Achievement in the Middle School Years. Table 1.1. Boston College: Chestnut Hill, MA.

NOTES:

1. Nations not meeting international guidelines are shown in parentheses.
2. Nations in which more than 10 percent of the population was excluded from testing are shown with a *. Latvia is designated LSS because only Latvian-speaking schools were tested, which represents less than 65 percent of the population.
3. Nations in which a participation rate of 75 percent of the schools and students combined was achieved only after replacements for refusals were substituted, are shown with a ▲.

◆ The international average is the average of the national averages of the 26 nations.

★ The international average is the average of the national average of the 41 nations.

● The country average for Scotland (or Spain) may appear to be out of place; however, statistically, its placement is correct.

■ The country average for Sweden may appear to be out of place; however, statistically, its placement is correct.

8

TWELFTH GRADE SCIENCE GENERAL KNOWLEDGE ACHIEVEMENT

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
Sweden	559
(Netherlands)	558
(Iceland)	549
(Norway)	544
(Canada)	532
New Zealand	529
(Australia)	527
Switzerland	523
(Austria)	520
(Slovenia)	517
(Denmark)	509

Nations With Average Scores Not Significantly Different From The U.S.

Nation	Average
(Germany)	497
(France)	487
Czech Republic	487
(Russian Federation)	481
(United States)	480
(Italy)	475
Hungary	471
(Lithuania)	461

Nations With Average Scores Significantly Lower Than The U.S.

Nation	Average
(Cyprus)	448
(South Africa)	349

International Average = 500

Source: Mullis et al. (1996) Mathematics and Science Achievement in the Final Year of Secondary School. Table 2.2. Boston College: Chestnut Hill, MA.

TWELFTH GRADE MATHEMATICS GENERAL KNOWLEDGE ACHIEVEMENT

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
(Netherlands)	560
Sweden	552
(Denmark)	547
Switzerland	540
(Iceland)	534
(Norway)	528
(France)	523
New Zealand	522
(Australia)	522
(Canada)	519
(Austria)	518
(Slovenia)	512
(Germany)	495
Hungary	483

Nations With Average Scores Not Significantly Different From The U.S.

Nation	Average
(Italy)	476
(Russian Federation)	471
(Lithuania)	469
Czech Republic	466
(United States)	461

Nations With Average Scores Significantly Lower Than The U.S.

Nation	Average
(Cyprus)	446
(South Africa)	356

International Average = 500

Source: Mullis et al. (1996) Mathematics and Science Achievement in the Final Year of Secondary School. Table 2.1. Boston College: Chestnut Hill, MA.

TWELFTH GRADE AVERAGE ADVANCED MATHEMATICS PERFORMANCE

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
France	557
(Russian Federation)	542
Switzerland	533
(Australia)	525
(Denmark)	522
(Cyprus)	518
(Lithuania)	516
Greece	513
Sweden	512
Canada	509
(Slovenia)	475

Nations With Average Scores Not Significantly Different From The U.S.

Nation	Average
(Italy)	474
Czech Republic	469
(Germany)	465
(United States)	442
(Austria)	436

Nations With Average Scores Significantly Lower Than The U.S.

Nation	Average
NONE	

International Average = 501

Source: Mullis et al. (1996) Mathematics and Science Achievement in the Final Year of Secondary School. Table 5.1. Boston College: Chestnut Hill, MA.

TWELFTH GRADE AVERAGE PHYSICS PERFORMANCE

Nations With Average Scores Significantly Higher Than The U.S.

Nation	Average
Norway	581
Sweden	573
(Russian Federation)	545
(Denmark)	534
(Slovenia)	523
(Germany)	522
(Australia)	518
(Cyprus)	494
(Latvia)	488
Switzerland	488
Greece	486
(Canada)	485
France	466
Czech Republic	451

Nations With Average Scores Not Significantly Different From The U.S.

Nation	Average
(Austria)	435
(United States)	423

Nations With Average Scores Significantly Lower Than The U.S.

Nation	Average
NONE	

International Average = 501

Source: Mullis et al. (1996) Mathematics and Science Achievement in the Final Year of Secondary School. Table 8.1. Boston College: Chestnut Hill, MA.

NOTE:
Nations not meeting international sampling and other guidelines are shown in parentheses.

WHAT DOES IT TAKE TO BE "FIRST IN THE WORLD"? IS IT POSSIBLE?

We know what it takes to have our students achieve at the same level as those who scored highest on the TIMSS. We know because 20 school districts outside of Chicago demonstrate a success story in raising student achievement based on the lessons of TIMSS. The First in the World Consortium gave their own students the TIMSS test to benchmark their performance against world-class standards. The performance of Consortium students was close to the first in the world on the 4th- and 8th-grade assessments; on the 12th-grade general mathematics and science assessments, student performance was, in fact, first in the world.

The secret to their success: Twice as many Consortium students study algebra by the end of eighth-grade as students in the United States as a whole, and all Consortium mathematics and science teachers either majored or minored in the subject area they teach. The majority of their seniors are taking or have taken calculus, or an advanced placement math or science course. The First in the World Consortium demonstrates that U.S. students can achieve to world-class levels of excellence when they are supported by high standards, a challenging curriculum, and effective teaching.

HOW GOOD IS GOOD ENOUGH?

"These (TIMSS) results are entirely unacceptable and absolutely confirm our need to raise our standards of achievement, testing, and teaching, especially in our middle and high schools—and to get more serious about taking math and science courses."[8]

U.S. Secretary of Education Richard Riley

Is TIMSS just one more set of test scores? And how do TIMSS scores compare with other test scores that indicate that student achievement in America has increased over recent years?

In the new global marketplace, companies must compete with other companies all over the world. In the future, in order to remain competitive, American workers must be among the most skilled in the world. A large component of an individual's knowledge and skill is determined by academic mastery in school. This is why international comparisons of student achievement are important, and why TIMSS scores are a call for employers to work with educators to improve the academic performance of all students.

It is true that student achievement has risen in America over the last decade. An indicator of this progress is the National Assessment of Educational Progress (NAEP), a highly regarded national achievement indicator. Recent math scores show positive results. For example, according to NAEP, the percentage of eighth-graders who "can add, subtract, multiply, and divide using whole numbers, and solve one-step problems" rose from 65 percent in 1978 to 79 percent in 1996. Table 1 demonstrates progress in math achievement:

TABLE 1—PERCENTAGE OF STUDENTS SCORING AT OR ABOVE THE "PROFICIENT" MATHEMATICS LEVEL

Years	1990	1996
Fourth-Graders	13%	21%
Eighth-Graders	15%	24%
Twelfth-Graders	12%	16%

That is the good news. The bad news is that the large majority of students do not achieve "proficient" status. The United States was the only country in TIMSS whose students dropped from above average in fourth grade to below average in eighth grade.

WHY IS THIS THE CASE?

There is no single answer to this question, but TIMSS results show several important differences between education in the United States versus other countries.

CURRICULUM

- The U.S. eighth-grade mathematics and science curricula are less focused and less advanced than that of other nations. For example, most other nations consider topics from algebra, geometry, physics, and chemistry while U.S. curricula continues to cover more repetitive and less challenging material.
- U.S. textbooks cover more mathematics and science topic areas than international textbooks. For example, the typical U.S. eighth-grade mathematics textbook covers 35 topics while the typical Japanese eighth-grade textbook covers only seven.
- U.S. eighth-grade mathematics classes require students to engage in less high-level mathematical reasoning than classes in Germany and Japan.
- In their final year of secondary school (12th grade for U.S. students), the proportion of graduating students currently taking mathematics was lower in the United States (66 percent) than the average in all the countries participating in the general knowledge assessments (79 percent). The same was also true for science (53 percent for the United States and 67 percent for all the TIMSS countries).

TEACHING

- Most eighth-grade U.S. mathematics teachers set a goal to teach students how to do something, while Japanese teachers set a goal to help students learn how to do something and also understand mathematical concepts so that they can solve future problems.
- Most U.S. eighth-grade mathematics teachers report familiarity with recommendations for reforming math instruction, although only a few were observed to apply the key points in their classrooms. Japanese teachers widely practice what U.S. mathematics reforms recommend.
- New teachers in the United States receive less on-the-job training and mentoring than do new teachers in Japan and Germany.[9]

WHAT DO WE MEAN BY CHALLENGING MATH AND SCIENCE?

FOURTH-GRADE MATH

- There are 10 girls and 20 boys in Juanita's class. Juanita said that there is one girl for every two boys. Her friend Amanda said that means 1/2 of all the students in the class are girls.

  Is Amanda right? Answer: _____
  Use words or pictures to explain why.

  Correct Answer Example:
  No, because 1/2 is 5 not 10 girls and it is not 20 boys.

  International Average Percent Correct: 15 percent
  - Singapore: 37 percent
  - Japan: 30 percent
  - United States: 17 percent
  - Canada: 12 percent

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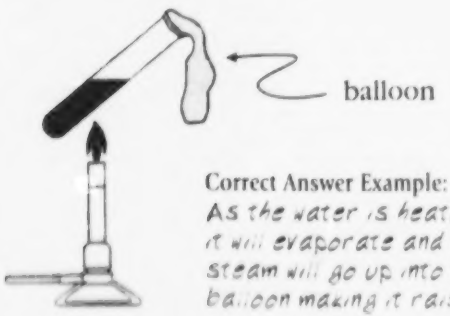
EIGHTH-GRADE SCIENCE

- The water in a tube is heated, as shown in the diagram. As the water is heated, the balloon increases in size. Explain why.



  Correct Answer Example:
  As the water is heated, it will evaporate and the steam will go up into the balloon making it raise.

  International Average Percent Correct: 58 percent
  - Korea: 75 percent
  - Czech Republic: 70 percent
  - Japan: 67 percent
  - Singapore: 58 percent
  - United States : 43 percent

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TWELFTH-GRADE MATHEMATICS GENERAL KNOWLEDGE

- Experts say that 25 percent of all serious bicycle accidents involve head injuries and that, of all head injuries, 80 percent are fatal. What percent of all serious bicycle accidents involve fatal head injuries?

  A. 16% B. 20% C. 55% D. 105%

  Correct Answer: B

  International Average Percent Correct: 64 percent
  - Netherlands: 83 percent
  - Sweden: 78 percent
  - Canada: 74 percent
  - Switzerland: 67 percent
  - United States: 57 percent

Source: IEA Third International Math and Science Study (TIMSS), 1994-95

TWELFTH-GRADE PHYSICS

- A car moving at a constant speed with a siren sounding comes toward you and then passes by. Describe how the frequency of the sound you hear changes.

  Correct Answer Examples:
  - The pitch is higher as the car comes closer and lower after it goes by.
  - When the car approaches, the wavelength of the sound is shorter than it is when the car moves away.

  International Average Percent Correct: 37 percent
  - Germany: 60 percent
  - Austria: 51 percent
  - Canada: 22 percent
  - France: 18 percent
  - United States: 12 percent

Source: IEA Third International Math and Science Study (TIMSS), 1994-95

These questions require students to think through multiple steps and apply concepts to solve the problem. The skills tested are among those students will need in their daily and professional lives—determining costs or making predictions based on available data. In short, exactly the kind of skills business increasingly requires.

Section Two

BUSINESS CARES ABOUT MATH AND SCIENCE ACHIEVEMENT

"For the business community, these (TIMSS 12th grade) results are chilling. In an increasingly global economy where workforce quality and skill levels are critical factors in achieving success, American business requires a world-class workforce if we are to continue to lead the world's economy."

Ed Rust
President and CEO
State Farm Insurance Companies
Chairman
National Alliance of Business
Chairman
Education Task Force of The Business Roundtable

Two decades ago, an international study like TIMSS would primarily have interested educators. Today, it is a wake-up call to every parent, business leader and political figure—to anyone who cares about his or her own future, and the future competitiveness of our country.

There is no doubting the importance of literature, history, and the arts in shaping our future workers and citizens; indeed, 90 percent of CEOs recently surveyed called study of the humanities essential to developing critical thinking.[10] But business can make a special case for the centrality of math and science in contemporary curricula. Mastery of challenging math and science concepts provide young job seekers with a passport to prosperity in the knowledge economy—as suggested in a recent comment by Maine Governor Angus King. The state "may still be known for lobsters and potato farming," he said, "but it is computer chips, telemarketing, and biotechnology that are driving the new economy."[11]

Individuals, companies, and society in general benefit when all students achieve challenging math and science standards. For example:

- A recent study at the University of Pennsylvania, showed that a 10 percent (or about one year) increase in the education level of a company's workforce increased productivity by 8.6 percent, while a comparable increase in capital equipment increased productivity by 3.4 percent. For non-manufacturing companies, the result was even higher—11 percent.[12]
- A new study reports that math and science proficiency boosts earning power by a remarkable margin. Bureau of Labor Statistics figures show that, on average, 28-year-old workers who tested in the top quartile of math skills on the National Assessment of Educational Progress earn 37 percent more than those in lower quartiles. A comparable advantage goes to those who test well in science.[13]

Why are the rewards so great? Because today's economy demands more than rote skills. It demands analytic power, disciplined thinking, and creative imagination. Mastery of math and science concepts is the foundation on which to build the skills necessary for success in today's changing economy.

The following examples highlight why math and science are integral to the modern workplace—and how a shortfall in skills can hamper growth.

BENEFITS REPRESENTATIVE[14]

An employee's 401(k) contributions and ROE contributions must be less than or equal to 25 percent of his gross pay (minus insurance premiums and 401(k) contributions). Employees whose percentage is greater than 25 percent are entitled to a refund. If my salary and contributions match those listed below, what is my actual percentage? What should my 401(k) refund be to decrease the percentage to 25 percent?

K = $3,000 401(k) contributions
M= $1,500 Employer's matching contributions
R= $400 ROE contributions
G= $20,000 Gross pay
P= $800 Pre-tax insurance premiums

IRS Formula:

$$\frac{K + M + R}{G - K - P} = .25$$

Solution:

$$\frac{3000 + 1500 + 400}{20000 - 3000 - 800} = \frac{4900}{16200} = .302 \text{ (30.2\%—actual \%)}$$

$$\frac{x + 1500 + 400}{20000 - x - 800} = .25$$

x = $2320

K - x = Refund

3000 - 2320 = $680 Refund

HEALTH CARE SPECIALIST[15]

Health Services uses a 0.5 percent solution of calcium gluconate as a 20-minute eye flush when an employee in the manufacturing area accidentally splashes hydrofluoric acid in his or her eyes. The calcium gluconate comes in vials of 10 percent concentration. The sterile saline water comes in a 1-liter I.V. bag. How many milliliters of 10 percent calcium gluconate solution must be added to the 1-liter bag of water to obtain the correct strength of calcium gluconate?

1 liter = 1000 milliliters

Solution: 1000 x .005 (5% solution) = 5 ml. (if full strength)

5 milliliters / .10 (10% concentration) = 50 ml.

MATHEMATICS AND WORK

- One study showed that almost 40 percent of all 17-year-olds do not have the necessary math skills...to hold down a production job in manufacturing.[16]
- When the National Skill Standards Board commissioned pilot projects to outline baseline skills in 12 industry sectors, 11 of the 12 reports recommended "some form of mathematics mastery beyond basic math (i.e., algebra, geometry, or trigonometry)." The level of math proficiency now required for entry-level jobs in many fields is ratcheting upward: manufacturing skill standards, for example, call for workers to "explain calibration requirements of various precision instruments"; chemical process industry standards ask that workers "use differential calculus to calculate rates" and "perform calculations using exponents." Automobile-autobody technicians should be able to "calculate the average (mean) of several measurements to determine the variance from the manufacturer's specifications." Welders should know how to "convert metric to customary units and vice versa."[17]
- Entry-level standards for the Will-Burt Company, a mid-sized metal fabricating and finishing company in Orrville, Ohio, have risen dramatically in the past two decades. Until the early 1980s according to CEO Harry Heatherstone, the only mandatory skill was reading, and being able to follow precise directions. Today, maintaining its "flawless" work for customers in the auto and construction industries requires teamwork, brain power, and 14th-grade math proficiency. The company now sponsors an education program to ensure that new employees have the skills required.[18]

The Will-Burt example begs a question: Would the company be asking for 14th-grade skills if American math students learned at the same pace as their counterparts in Japan? In their recent book, *Teaching the New Basic Skills*, Richard J. Murnane and Frank Levy write that the "basic" math skills required in the average American workplace are actually those which ought to be learned by ninth grade—yet many American students graduate from high school without mastering them.[19]

SCIENCE AND WORK

- Dr. Michael Phillips, health careers education consultant at Sutter Health, explains why the San Francisco healthcare provider supports the Health Careers Academy at Encina High School: "Even our entry-level workers need pretty high-level skills. Our 'janitors' have to understand bio-hazardous materials waste management. They have to know what to do with a chemotherapy spill. That's not just pushing a broom."[20]

13

ENGINEER[21]

To ensure that probe test machines are testing correctly—that bad devices and good devices pass—the same wafers are tested on two different machines, a process called "correlating machines." Two machines are considered "correlated" if the number of good devices found by the second machine is within 3 percent of the number found by the first machine on a given wafer. Machine A finds 289 good devices on a given wafer. When the same wafer is tested on Machine B, it finds 298 good devices. Determine whether the two machines are correlating.

Solution:

$$\frac{289}{298} = .9697$$

1 - .9697 = .0307 or 3.07%;
CLOSE, but NOT within the 3 percent limit.

- Laser surgery, environmental tracking, and traffic sensors: At the heart of these and other cutting-edge industries is "photonics"—the process of using light-based information. Technicians in this emerging field must "calculate frequency, period, amplitude, displacement, wavelength, and speed for harmonic waves," among a host of other physics, chemistry, and biology skills.[22]
- In the greenhouses, farms, and laboratories developing new strategies for feeding the planet, "agricultural biotechnology technicians" perform a range of critical functions from tissue cultures to carrying out research trials. According to national skill standards for this burgeoning industry, these entry-level jobs require candidates who can "describe the functions of enzymes and metabolic pathways," explain the role of a micro-organism as a disease vector," and "describe/explain chemical reactions."[23]
- Among the "new basics" for entry-level workers at Intel are one year each of chemistry, physics, and electronics, plus a firm grasp of basic science.[24]
- An entry-level automobile worker, according to an industry-wide standard, needs to be able to apply formulas from physics to properly wire the electrical circuits of a car.[25]
- According to a survey conducted for the Bayer Corporation, 84 percent of corporate human resource directors believe that "science literacy will be a requirement for entry- level jobs in the future."[26] If so, business will have to search hard, because the general level of science learning in this country is inadequate. A recent survey by the National Science Foundation uncovered some significant gaps in Americans' grasp of basic science knowledge, with just 25 percent of adults surveyed getting passing grades. Only 9 percent knew what a molecule was; only 21 percent could define DNA—and less than half knew that the Earth orbits around the sun yearly.[28]

"...much 'hidden' mathematics is embedded throughout the occupational skill standards under other headings (e.g., problem solving, quality control, or planning). For example, to understand the role of profits in an organization requires understanding aspects of mathematics (e.g., probability and optimization) that are often not made explicit. Organizing a shoe store stockroom, for example, involves subtle questions of timing, priority, and efficiency that are at their heart intrinsically mathematical."[27]

THE BILL IS COMING DUE

"Instantaneous communications, advanced manufacturing techniques, worldwide marketing practices, and a much more sophisticated capital formation process continue to increase the velocity of change to a point unprecedented in human history and create a disconnect between our emerging labor force and the needs of a global marketplace."[29]

NORMAN AUGUSTINE
FORMER CHAIRMAN, LOCKHEED MARTIN CORPORATION

Our educational shortcomings are hitting home. Skill deficiencies in the American workforce are hindering American productivity and competitiveness in the world market. Job vacancies in high-skill industries and exorbitant training costs to teach remedial skills are standard fare in American companies. In a survey of 430 CEOs of product and service companies identified in the media as the fastest growing U.S. businesses over the last 5 years, 69 percent of CEOs reported the shortage of skilled, trained workers as a barrier to growth, up from 59 percent the year before.[30]

Worst of all, job vacancies and high remedial training costs prevent companies from providing the kind of training they do best: cutting-edge, industry- and job-specific training that makes American workers the best in the world. If all students were graduating from high school with a strong grounding in math, science, and other academic skills that provide the foundation for this type of advanced training, the possibilities for success would be endless. The following examples tell us that this ideal is far from reality:

- According to the National Association of Business Economists, 50 percent of companies surveyed in January 1997, reported skilled labor shortages—nearly doubling since a survey in July 1995.[31]
- In the white-hot high-tech economy of northern Virginia an estimated 1 in 10 information technology jobs cannot be filled (a rate comparable to the national rate). According to David Lucien, president of the consulting firm Interpro, "There is a deep concern about the region's ability to provide the human capital needed to sustain economic growth."[32] Far from being isolated in one region or industry, this skills shortage is a growing national problem. According to the Information Technology Association of America (ITAA), " [s]agging interest in math and science among U.S. students is creating a shortage of skilled information technology workers.." ITAA's president Harris Miller points out, "[T]he problem is not limited to high-tech firms. Companies like Federal Express that rely on information systems to service their customers find that a lack of skilled Information Technology workers is hurting them as well."[33]
- "...almost 90 percent of manufacturers report a dearth of qualified workers in at least one job category; and that problem has gotten progressively worse during the 1990s," according to the National Association of Manufacturers. In a survey that drew responses from about 450 manufacturers of all sizes, NAM found that "more than two-thirds are having difficulty improving productivity (37 percent) and upgrading technology (36 percent) due to employee skill deficiencies; and half found it difficult to empower employees to take on more line responsibility."[34]

The following section highlights specific strategies that business can take to prepare today's students with the skills they need to be successful in tomorrow's world. Section four offers questions that business leaders can use to begin or continue conversations with other stakeholders—parents, educators, students, policymakers—about efforts to improve math and science achievement in their community. Section five outlines resources that can assist employers in supporting student achievement.

Section Three

THE BUSINESS ROLE IN IMPROVING MATH AND SCIENCE ACHIEVEMENT

"We view education reform... as a marathon, not a sprint."

Richard W. Vague
Chairman, First USA Bank

School-business partnerships are not new, but the rapidly changing workplace and the academic skill deficiencies that TIMSS results reveal provide new impetus for business leaders to support schools in the most effective ways possible.

Recognizing the important connection between math and science achievement and successful workplace performance, many business leaders are spearheading efforts to improve math and science achievement. While there are many different strategies for business to take, the common thread is a long-term, substantive commitment to working with educators to improve academic achievement for all children.

SUMMARY OF BUSINESS STRATEGIES

Strategies can be broken down into the following categories:

(1) Articulate workplace academic skill requirements; communicate these needs to schools, parents, and students on a regular basis; and ensure these skills are incorporated into academic standards.

(2) Support more rigorous teacher training that incorporates mastery of content as well as its application to success in the workplace.

(3) Support programs that expose students to the world of work.

(4) Support the use of student and system performance data that are clear, reliable, and broadly disseminated.

(5) Use student achievement in hiring decisions to send the message to all students that academic achievement is important.

(6) Encourage employees, especially those who are parents, and other community stakeholders to increase their involvement with local schools to help students achieve challenging academic standards.

The following pages describe these strategies in more detail and provide examples of activities led by companies and business coalitions. Examples are divided into "policy" and "practice" to demonstrate the variety of ways that business leaders can act to improve education.

***A continually growing collection of similar strategies can be found on the BCER homepage at* www.bcer.org**

(1) Articulate Workplace Academic Skill Requirements, Communicate These Needs to Schools, Parents, and Students on a Regular Basis; and Ensure These Skills Are Incorporated into Academic Standards

"Colleges drive the high school curricula by making admissions standards public and quantified. Businesses should do the same."[35]

BEYOND EIGHTH GRADE
NCRVE MEETING IN HARRIMAN, NY

High academic standards ensure that all students strive to meet the same challenging goals, though the methods of learning may vary. Clearly defined standards of achievement not only provide students with information about what is required to be successful in a changing world, they also enable employers to use student achievement as a reliable measure of skill. As a result, the hiring process becomes easier and more reliable, students are motivated to achieve at higher skill levels as employers are able to reward high-skilled workers with better wages, and the skill level of the workforce increases. Companies are able to shift training away from remedial skills to industry-specific training, a key to increased productivity.

The national business community is committed to helping educators and policymakers set challenging academic standards, applicable to every student in every school; assessing student and school-system performance against those standards; and using that information to improve schools and create accountability, including rewards for success and consequences for failure. These commitments are the foundations of the **Common Agenda for Improving American Education**, jointly issued by the National Alliance of Business, The Business Roundtable, and the U.S. Chamber of Commerce, the nation's three largest business organizations, representing more than 218,700 employers nationwide.

REPRESENT THE BUSINESS VOICE ON STANDARDS-SETTING GROUPS

In addition to supporting educators and policymakers, business has an important role to play in ensuring that all students are expected to meet challenging academic standards. By articulating the academic skills required for success in the workplace, and working with standards developers to incorporate these skills, employers will ensure that a successful high school education opens the door to success in higher education, technical training, and the workplace.

ARTICULATE WHY ADVANCED ACADEMIC SKILLS ARE NECESSARY ON THE JOB

The jobs of today (not to mention those of tomorrow) are radically different than those of a generation ago. In 1950, 65 percent of jobs were considered "unskilled" versus 15 percent that required skilled workers; by 2000, the reverse will be true—only 15 percent of jobs will accommodate unskilled workers, versus the 65 percent that will require people with strong academic and technical skills.[36]

Business leaders must articulate the changing needs of the workplace, demonstrate how these advanced skills are used on the job, and hire recent graduates who possess these skills.

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AT THE POLICY/LEADERSHIP LEVEL...

Developing and Aligning Academic Standards, Assessments, and Professional Development

Delaware's Business/Public Education Council (BPEC), made up of CEOs from Delaware's major corporations and key members of the public education community, has served as the primary conduit for channeling the business community's momentum to improve education. Business leaders in Delaware were instrumental in crafting and implementing *New Directions*, Delaware's comprehensive, standards-based effort to improve its education system. The business community played a crucial role in developing statewide academic standards by identifying and articulating the critical skills that graduates need to be successful in the workplace and in life. The standards in the core disciplines—science, math, social studies, and English/language arts are now being implemented. The business community again played a key role in advocating the design and establishment of statewide assessments which will measure what students know and are able to do matched against state standards. BPEC is now involved in the most important phase of their reform efforts—school accountability linked with meaningful professional development. *For more information, contact Paul R. Fine at 302-984-1700.*

Articulating the Skills for Success

Under the leadership of Chairman Robert Staton, President, Colonial Life and Accident Company, the **South Carolina Business Center for Excellence in Education (SCBCEE), an affiliate of the South Carolina Chamber of Commerce**, is helping employers articulate the skills that students will need on the job. SCBCEE is working with local chambers of commerce to garner input for the revision of the 12th grade exit examination. Seeking to make the high school diploma a certificate of competence, SCBCEE co-sponsored seven regional forums to solicit business input to ensure that the revised exam meets the employer's needs of an employee. Through a membership survey, SCBCEE updated its listing of prioritized workplace competencies and skills that the State Department of Education has, in turn, incorporated into the state's K–12 curriculum frameworks. In addition, SCBCEE developed and distributed two student brochures on the theme "Get Job Ready: It's Your Move." One brochure focuses on the general workplace competencies needed for employment while the second one highlights specific occupational information—jobs in demand, educational requirements, and so forth. Finally, the South Carolina Chamber of Commerce has taken a leadership role with the SCBCEE in launching an initiative to assess skill and job needs in a comprehensive manner. Taking the form of a survey, the instrument will address jobs and the skills associated with them. Called SKILLS THAT WORK, the initiative will also address areas with the most critical shortage of trained employees and the level of education and training needed for entry-level positions. The survey will be conducted every 2 years and will provide the data needed for the SCBCEE to become a clearinghouse for students and career guidance professionals. *For more information, contact Ellen Hayden at 803-799-4601.*

IN PRACTICE...

Motivating Students to "Take Charge" of Their Learning

The **Washington Roundtable** has produced an award-winning video called *Take Charge*, aimed at providing students with information about the academic skills today's workplace requires. In the video targeted at high school students, "twenty-somethings" discuss the academic skills that are necessary for them to do their jobs. A bank manager at Sea First Bank discusses how he uses math to arrange the terms of consumer loans, including payment schedules and interest rate calculations. A machinist at Boeing discusses how he uses computers to make airplane parts with high degrees of precision. *To order a copy of this video or for more information about Washington Roundtable activities, contact Steve Mullin at 206-623-0180.*

Linking Academic Skills and Workplace Needs

Since its inception in 1988, the **Wichita Business Education Success Team (BEST)** has focused on creating flexible life-long education and training systems for Wichita and Sedgwick County. Under the leadership of Fred Bright of Cessna Aircraft, BEST has adopted Work Keys, a tool used to bridge the gap between academic and skill standards. The Work Keys system measures individuals' workplace skills against the requirements of specific jobs. Components include assessing skills and scores performance, identifying crucial skills and the level of proficiency necessary for effective work-related performance, assisting schools in supplementing work-based competencies and providing reports on individuals' skill level, interest, and experience. By encouraging communication through the development of a common language for employers and educators, Work Keys facilitates instruction that enables individuals to improve skills that are valuable in the workplace. *For more information, contact Suzie Ahlstrand at 316-268-1135.*

(2) Support More Rigorous Teacher Training That Incorporates Mastery of Content as Well as its Application to Success in the Workplace

"Without a sustained commitment to teachers' learning and school design, the goal of dramatically enhancing school performance for all America's children will remain unfilled."

Doing What Matters Most: Investing in Quality Teaching. Prepared for The National Commission on Teaching and America's Future, 1997

Despite the power of standards as an educational tool, standards cannot be mistaken for a magic wand. The mere existence of standards, quality assessments, and accountability measurements cannot yield higher student achievement unless teachers are prepared to rise to the challenge. Too often teachers are ill-equipped to meet these demands.

Most teachers, including education professors, have rarely left the academic environment, going straight from being a student to teaching. As a result, many teachers are not aware of the advanced skill requirements associated with workforce changes. Moreover, many math and science teachers have very limited academic preparation in the subjects they teach. A critical component of preparing students to succeed on the job is ensuring that teachers have a mastery of mathematics and science and the understanding of how academic knowledge is applied on the job.

Now is an excellent time to address these challenges. Approximately half of our nation's 2.7 million teachers will retire in the next decade. Using the most conservative estimates, the nation will need to hire at least 2 million teachers over the next 10 years. With so many new teachers entering the nation's classrooms, quality professional development efforts can significantly improve the way America's students are prepared for their lives.

AT THE POLICY/LEADERSHIP LEVEL...

Urge state/local policymakers to encourage teachers to meet National Board for Professional Teaching Standards (NBPTS)

National Board for Professional Teaching Standards (NBPTS) Established in 1987, NBPTS is a non-partisan, independent, non-profit organization supported in part by the federal government and by American corporations and private foundations. Its mission is to establish high and rigorous standards for what accomplished teachers should know and be able to do, to create and operate a national voluntary system to assess and certify teachers who meet these standards, and to advance related education reforms for the purpose of improving student learning in American schools. NBPTS standards are based on subject matter expertise and knowledge of student developmental levels. National Board Certification is achieved after an extensive performance-based assessment process. There are currently 912 National Board Certified Teachers and over 2,000 more in the process of seeking certification. The goal is to certify 50,000 teachers in the next 5 years. *For more information, contact Paula Shoecraft at 248-351-4444 and/or visit the NBPTS website at www.nbpts.org.*

Rewarding Expertise

The **Public School Forum of North Carolina**, a coalition of state business leaders, elected officials, and educators recently supported major legislation changes creating 12 percent pay incentives for teachers who receive certification from the National Board for Professional Teaching Standards. As this practice of rewarding NBPTS certified teachers spreads, it will encourage other current and prospective teachers to seek the same certification. The Public School Forum recently conducted a statewide audit of the state of mathematics and science instruction. The report, "A State of Disconnectedness," led to the creation of a task force charged with better aligning the state's resources. *For more information, contact John Dornan at 919-781-6833.*

IN PRACTICE...

Expose teachers to the world of work through internships, career days, mentoring, and workplace-based curriculum supplements

Helping Teachers Link Theory and Application

The **Somerset-Hunterdon Partnership**, led by Charles Bartolotta, TCI Communications, Inc., and Joseph McGarry, Superintendent, Bridgewarter-Raritan School District, developed the Science Alliance, an education and industry collaboration focused on teacher training in science, math, and technology to enhance K–12 curriculum. Supported by 102 companies, the program meets the increasing need for a scientifically literate population and serves six counties in central New Jersey. Since its inception in 1991, working partnerships among scientists, engineers and technicians with educators have created over 250 innovative, standards-based, consumer-relevant, hands-on science modules integrating real-world applications with textbook theory. *For more information, contact Mary Ribeiro at 908-725-6032.*

Enriching Instruction Through Experiences Outside the Classroom

Industry Initiatives for Science and Math Education (IISME), founded in 1985 by a consortium of San Francisco Bay Area companies and government laboratories in partnership with the Lawrence Hall of Science at the University of California at Berkeley, established the IISME Summer Fellowship Program, which provides K–14 teachers with mentored, paid summer jobs in applied science and mathematics and access to the latest technology and technically trained professionals in industry, government labs, and universities. Sponsors enable teachers to spend 10 percent of their fellowship time developing an action plan to translate their summer experience into enriched instruction for students. The IISME program has impacted more than 500,000 students, and over 90 percent of the 600-plus teachers who have participated in the summer fellowship program rate IISME as one of the best professional development experiences they have had. *For more information, contact Kaye Storm at 650-326-4860 or kayestorm@aol.com or check out IISME's website at www.emf.net/~iisme.*

Training Master Teachers To Promote Effective Practices

The **Public Education & Business Coalition (PEBC's) Teaching & Learning Center** provides a full range of professional development opportunities to assist schools and teachers in pursuing professional learning that closely matches their needs and long-range goals. Originally funded by foundations and business members of PEBC, the Center has trained 49 master teachers who work in over 55 schools each year. In classrooms, the master teachers work with participating teachers to support and enhance good teaching practices. In addition, PEBC has just formed a cadre of trainers to work with schools developing school-to-career systems. These trainers are assisting schools to develop teacher externships in the workplace, integrated curriculum, experience-based learning and work-based experiences for students.

Program evaluation has demonstrated promising results. For example, students in classrooms of teachers receiving the PEBC's professional development in reading instruction make greater gains in their reading comprehension than students in classrooms of teachers not receiving the training. *For more information, see PEBC's website at www.pebc.org or contact Barbara Volpe at 303-861-8661.*

(3) Support Programs That Expose Students to the World of Work

"If we are going to be competitive in the global marketplace, it has to happen both in the classroom and on the factory floor."

Albert Hoser
President and CEO, Siemens Corporation

In the classroom, motivating students to learn is often the key to high achievement. Students frequently fail to understand how academic learning is applied or rewarded in the real world. Exposing students to the link between academic subjects and workplace success can make learning exciting and motivate students to achieve. Many students, including those for whom school is difficult or boring, could be well served by learning traditional subjects (English, algebra, biology) through practical applications. School-to-Career initiatives combine demanding core academic curriculum with practical work-based application. This learning strategy, linked to high academic standards, can provide better education, workforce preparation, and the ability to learn throughout a lifetime.

AT THE POLICY/LEADERSHIP LEVEL...

As the federal venture-capital grants which have funded school-to-work programs phase out, it is an important time for the business community to play a leadership role in programs which link school and the workplace. The following examples demonstrate this type of leadership at the national level:

- The **National Employer Leadership Council (NELC)** is a non-partisan coalition of chief executive officers from small, large, and mid-sized companies. Serving as a collective voice for business in the ongoing national dialog around school-to-work issues, the NELC has created the Employer Participation Model to help employers of all sizes customize their participation in school-to-work activities. Using the model as a foundation, companies can evaluate resources and target them to areas of opportunity. *For more information about the Employer Participation Model, contact the NELC at 800-360-NELC.*
- The **National Alliance of Business** and seven other national business organizations jointly issued a statement entitled, "School-to-Career Initiatives: The Business View," which outlines the important goals and components of successful programs, and corrects some commonly held misconceptions about school-to-career initiatives. *For a copy of this statement, contact the National Alliance of Business at 800-787-2848.*

IN PRACTICE...

Lend business expertise to local career academies

Offering a Career Context for Learning

Career academies are career focused "schools within schools." **The Philadelphia High School Academies, Inc. (PHSA)** has provided an effective vehicle for attacking the drop-out problem and unemployment among the city's youth for more than a quarter of a century. At the Aviation and Aerospace Academy, one of PHSA's 11 career academies, students combine academic studies with training in the theory, operation, and maintenance of aviation and aerospace technology. As a result of this approach, students know that the knowledge and skills they are learning will help prepare them to succeed in the world of work. Learning is more relevant because students see learning applied in a career setting—in this case, the aviation and aerospace industries. Students are exposed to the myriad of career opportunities available within the commercial, governmental, and military sectors of the aviation and aerospace industry. For example, last May, United Airlines and the U.S. Air Force Academy co-sponsored a 4-day excursion to the U.S. Air Force Academy for 35 students. Students were paired with cadets and lived with them on campus where they experienced the life of a cadet for their entire stay. En route to the U.S. Air Force Academy, students participated in a tour highlighting various aspects of commercial aviation, including pilot and mechanic briefings and a plane inspection. These experiences represent a few examples of the Academies' efforts to enhance the educational and career opportunities for students. *For more information about Philadelphia High School Academies, Inc., contact Natalie S. Allen at 215-546-6300.*

Invite students into your company and provide work-based learning to reinforce school-based learning

Opening the Workplace to Students

Under the leadership of Jay Van Den Berg, Vice President, Whirlpool Corporation, the **Community Partnership for Lifelong Learning** (Michigan) sponsors the *On Location* student internship program. Widely recognized as a model business-education partnership, On Location brings over 400 sixth-grade students and their teachers into the workplace for week-long internships. The hands-on work experiences are designed to have students discover, firsthand, how skills learned in the classroom, such as reading, math, communication, computer literacy, and teamwork, relate to the workplace. Businesses report that employees often rediscover satisfaction in their own work, improving morale and performance. *For more information, contact Al Pscholka at 616-925-6100.*

Equipping Students With Advanced Academic Skills

Siemens USA's apprenticeship programs combine an academic curriculum with hands-on practical training in the production manufacturing environment. The students are trained by master craftsmen whose exacting standards are producing highly skilled workers prepared to compete effectively in a global economy. All students participate in a paid work experience as a core element in on-the-job training, which is supplemented by a high school curriculum that seamlessly articulates to a degree-granting college program. Students also receive school credit for worker-training activities. Upon completion of the program, Siemens provides industry-recognized credentials that demonstrate mastery of industry-driven proficiencies. Students then have several options, including: working for the facility in which they have been trained; being referred to other Siemens companies; pursuing other employment; or furthering their education at the community-college or 4-year level, reapplying for work at a higher level. Siemens USA has set up its first five pilot apprenticeship programs in Georgia, Florida, California, Kentucky, and North Carolina. The National Alliance of Business is helping Siemens develop a framework that facilitates replication of the program in other sites. *For more information, contact John Tobin at 212-258-4046.*

(4) Support the Use of Student and System Performance Data That Are Clear, Reliable, and Broadly Disseminated

"If you can't measure it, you can't manage it."

Frederick W. Smith
CEO Federal Express

A continuously improving system is dependent on basing decisions on good information from both within and outside of the system. Successful businesses' use of customer satisfaction surveys, benchmarking, feedback loops, and other quality practices attest to the benefits of data-driven decisions.

Education systems can adapt these "business" strategies to support a standards-driven approach to improving student achievement. Standards, assessments, accountability systems, professional development, and curricula must all be aligned to produce improvements in student performance. Even the boldest standards are meaningless without specific goals and measures that are used to track performance, and an assessment system that provides data for and on students, and for teachers and administrators to use to gauge and tailor their teaching and learning. Similarly, standards that articulate what students should know and be able to do, as well as actual student and system performance on assessments need to be benchmarked against national and international standards of excellence and against the best schools and districts.

Given the importance of data-driven decision-making, the national business community endorsed the initiative to develop voluntary national tests, originally proposed by President Clinton in his 1997 State of the Union address, to measure student reading skills in the fourth grade and mathematics skills in the eighth grade. Business groups such as the National Alliance of Business, The Business Roundtable, and the U.S. Chamber of Commerce supported this idea because these tests will provide a national benchmark in reading and an international benchmark in mathematics that parents and educators can use to learn how their own children and students are performing.

AT THE POLICY/LEADERSHIP LEVEL...

Support student and school assessments that provide accurate and useful information, and ensure this information is widely disseminated to parents, community leaders, and others

BENCHMARKING FOR RESULTS

To help governors, business leaders, and state education policymakers improve education in their communities, a new independent, non-partisan, not-for-profit organization called **Achieve** was created. Achieve has three purposes: (1) to serve as a resource center to states on standards, assessments, accountability, and technology; (2) to help states benchmark their academic standards and assessments against the best national and international exemplars, and to provide advice and assistance to states on implementation strategies; and (3) to provide sustained public leadership and advocacy on behalf of the movement to raise academic standards and improve student performance. *For more information, contact Bob Schwartz at 617-496-6300 or visit the website at www.achieve.org.*

STAYING THE COURSE

The **Massachusetts Business Alliance for Education (MBAE)**, under the leadership of John Rennie, Chairman and CEO, Pacer Infotec, brings together coalitions of business leaders, thus representing hundreds of business leaders across the state. MBAE was a key player in the creation and passage of the state's historic 1993 Education Reform Act. Currently, MBAE is providing the business voice as state decisionmakers implement standards, develop curriculum frameworks, design assessments, and create greater school and district accountability. In spring 1998, students will take the first tests developed under the new accountability system. MBAE continues to monitor implementation and issue reports and recommendations on strengthening reform in Massachusetts. *For more information, contact Paul Reville at 508-754-9425.*

IN PRACTICE...

Work with local schools and school districts to gather and use data effectively

ALIGNING WORKPLACE EXPECTATIONS AND GRADUATION REQUIREMENTS

Due in large part to the efforts of the **Maryland Business Roundtable for Education (MBRT)**, Maryland is one of the leading states in the effort to reform high schools by raising standards, developing assessments, reporting individual student data, and requiring successful achievement on end-of-course tests to attain a diploma. The business community in Maryland has worked closely at every step of the standards setting process and now, assessment development, to ensure that the skills and knowledge for success in the workplace are being taught and learned in schools. The business community was a strong supporter of linking the tests to graduation and thereby increasing the standards all students in Maryland must meet. MBRT continues to work with all constituencies—teachers, parents, civic leaders, policymakers—to build support for aligning the education system to the new standards. *For more information, contact June Streckfus at 410-727-0448.*

USING DATA TO IMPROVE TEACHING AND LEARNING

Texas Business & Education Coalition (TBEC) is helping strengthen the Texas Academic Excellence Indicator System (AEIS), one of the nation's most comprehensive and cutting edge computerized data information management systems. Currently, every school campus and district receives a detailed report of its demographics, staffing, budget, and student performance from the Texas Education Agency accompanied by a User's Guide, Evaluating School Performance. TBEC is working with IBM's Reinventing Education Project to expand this system into a longitudinal database for every student in Texas. In the future, the state data system will be integrated with district and campus systems so that every teacher will have information about their students' performance against specific learning objectives to help them develop more effective teaching strategies. *For more information, contact John Stevens at 512-480-8232.*

(5) Use Student Achievement In Hiring Decisions To Send The Message To All Students That Academic Achievement Is Important

In a recent Public Agenda survey, 50 percent of students surveyed said employer use of their student records would motivate them to work harder in school.[38]

GETTING BY: WHAT AMERICAN TEENAGERS REALLY THINK ABOUT THEIR SCHOOLS
REPORT FROM PUBLIC AGENDA - 1997

"Business must go beyond adopt-a-school programs. We have to join with schools and send a clear message to teenagers and their parents: academic work in high school matters."

LOUIS V. GERSTNER, JR.
CHAIRMAN AND CEO, IBM CORPORATION

All students need incentives to meet high standards and become the life-long learners that our changing economy demands. Lacking incentives to study hard and achieve academic excellence, many students—particularly those not bound for college—simply do the minimum amount of work required to get by.

Businesses can help solve this problem by requesting school records of prospective employees. When employers bring academic records into the hiring decision, they motivate students by sending a powerful message: "We care about your performance and attendance in school, and we will reward hard work and accomplishment with better employment prospects."

When students learn that employers in their area want employees who can read and write well, problem-solve and reason—and want proof of those skills—they begin working harder in school. Employers, as a result, gain access to a wider supply of skilled, capable workers.

IN POLICY AND PRACTICE...

Making School Records Meaningful to Employers

The **business community in Nelson County, Kentucky**, pledged to use transcripts in hiring if these records were more useful. Local educators rose to the challenge by working together to standardize definitions of grades. Now an "A" in English at a city school means the same thing as an "A" in English at suburban and rural schools. School districts also give employers information about how letter grades translate into specific skills. As a result, more area employers are using transcripts in their hiring processes. *For more information, contact Susan Vaughn at Nelson County Schools at 502-349-7000.*

Using School Records in Hiring and Getting Bottom-Line Results

Since 1989, the **Eastman Chemical Company**, which employs 12,000 workers in Kingsport, Tennessee, has been requiring school records as one of many pieces of information it collects about job applicants. The job applicant is responsible for providing Eastman interviewers with a high school or college transcript. The company is looking for evidence that entry-level candidates satisfactorily completed certain courses, because a job analysis revealed that specific courses in math, science, and English teach skills that many Eastman employees use. To make sure Eastman's decision makers are using school records as effectively as possible, local high schools guidance counselors teach them how to interpret the information contained in transcripts. Eastman has seen real benefits from using school records over a relatively long period of time, and local high schools are seeing dramatic enrollment increases in higher level math and science courses. *For more information, contact Paul Montgomery at 423-229-1413.*

Working With Educators To Send the Message That School Counts

Kodak recently launched a company-wide policy of asking for transcripts or other school records as part of their hiring process. Application forms for entry-level operator positions at Kodak in Rochester now state that individuals out of high school 5 years or less, with no advanced degree, must provide a certified school-based record (such as a transcript) as part of their application. Kodak and school officials emphasized that school transcripts will supplement—not replace—previous criteria considered for employment, including pre-hire tests, work experience and interview performance.

The Rochester City and Greece school districts assisted Kodak in changing hiring practices for entry-level operator positions. Guidance counselors from both school districts advised Kodak on how to understand and benefit from high school transcripts. "The intent of this initiative is not to require a transcript to be hired at Kodak," said Michael Morley, Senior Vice President and Director, Corporate Human Resources, Kodak. "It is intended to provide additional information to help us develop a more complete picture of an applicant's skills, which will help us to make better hiring selections." *For more information, contact Anne Miller at 716-724-5026.*

MAKING ACADEMICS COUNT CAMPAIGN

Working in conjunction with the Business Coalition for Education Reform, in the summer of 1997, the National Alliance of Business (NAB) kicked off a 2-year nationwide effort to reinforce the connection between school performance and workplace success. This campaign, **Making Academics Count**, is one part of NAB, The Business Roundtable, and the U.S. Chamber of Commerce's **Common Agenda for Improving American Education**.

The goal is to have at least 10,000 companies of all sizes asking for school records and other profiles of academic performance as part of their hiring practices. NAB is providing tools and assistance to business leaders, educators and other members of the community to help them in this effort. *For more information about how your company can start asking for student records in the hiring process, contact Elizabeth Pauley at the National Alliance of Business at 800-787-2848.*

(6) Encourage Employees, Especially Those Who Are Parents, and Other Community Stakeholders To Increase Their Involvement with Local Schools To Help Students Achieve Challenging Academic Standards

The process of building system-wide capacity to support increased math and science achievement requires input from all stakeholders—parents, teachers, students, business and community leaders, elected officials, and others. "Selling" the process is important, as is an ongoing communications strategy to engage the public.

We also know that the children who do best in school are those whose families care about their education and are involved in their learning. Given the importance of education to the caliber and competency of our future workforce, many employers have found ways to encourage involvement by their own employees in helping students learn. Businesses win too by improving employee morale, productivity, and motivation. Here are a few options that every employer can consider:

- Create and promote policies that make it possible for employees to be involved in classroom or after-school activities by providing flextime, matching leave, job-sharing, or time off.
- Support programs at the worksite or in the community that help train employees to become involved in education.
- Work with schools to help them better meet the needs of employed parents through better scheduling of parent/teacher conferences, voice mail, and parent resource centers in schools.
- Help establish a homework hotline for parents, and support employee-led efforts that provide mentoring, tutoring, and guidance to those students most in need.

IN POLICY AND PRACTICE...

INFORMING PARENTS AND STUDENTS ABOUT ACADEMIC STANDARDS

The **Boston Plan for Excellence** is a local education foundation which funds whole-school change in the city's public schools. To generate support for the district's new academic standards, the Boston Plan is collaborating with the Boston Public Schools and the daily newspapers to produce two new publications for parents and citizens. "Great Expectations," funded by BankBoston, John Hancock Financial Services, and Fidelity Investments, is published four times each year and inserted pro bono by *The Boston Globe* into local editions of the paper. Parents and citizens can also get copies of the colorful tabloid through the schools, libraries, health centers, and other sites. In all, 200,000 copies are being distributed. With a 300,000+ circulation, *The Boston Herald* is dedicating one page each month to "Learning Matters," with information for parents on how to help their children meet the new academic standards. Each issue includes a feature specific to the standards; one issue described the "what and why" of new state tests, for instance, while another issue suggested how to help a child with a science project. For more information, contact Mary Ann Cohen at 617-350-7600.

ENGAGING STUDENTS IN MATH

The **Greater Milwaukee Education Trust's** *MATH, IT'S NOT A PROBLEM!* is a public information campaign targeted at stimulating middle school students' interest in math achievement. Components of this campaign include: (1) videos featuring application of math in real life situations—including how to use math to lay out an itinerary for getting to Sturgis with the CEO of Harley Davidson and demonstrations of math usage at other local businesses, including Allen-Bradley and the Milwaukee Bucks basketball team. These videos were sent to every eighth-grade math teacher in the district along with a teacher's guide; (2) movie trailers featuring Motown stars talking about the importance of math for kids' futures; and (3) the annual MATH GAME—over 200,000 middle school students across the state each year for the past 5 years have played this applied math game. Local popular radio stations and other media outlets team up with The Trust, local corporate sponsors, and Milwaukee math teachers to develop all questions and highlight the 613 prize winners a year. *For more information, contact Edward Anhalt at 414-287-4145.*

CONNECTING PARENTS, STUDENTS, AND SCHOOLS THROUGH VOICE MAIL

The **American Business Collaboration for Quality Dependent Care** started the Bridge Project in 1995, which connects parents and schools through voice messaging. At the end of the school day, a teacher simply picks up any phone and records a summary of the learning experience. The brief message tells parents about homework assignments, study expectations and how parents can help. When parents call to listen to the message, they can find out how to manage and support their children's learning at home. The American Business Collaboration, composed of 21 corporations, including American Express, Allstate Insurance, and NYNEX, funded implementation of the Bridge Project in 102 schools which serve children of their employees. The project is currently being expanded to more than 225 additional schools nationwide. *For more information, contact Jerold Bauch at 615-322- 8080.*

Section Four

QUESTIONS FOR YOUR COMMUNITY

One of the most important elements in achieving systemic reform to improve math and science achievement is to engage parents, employers, educators, colleges, and community members in discussions about local and state efforts to improve math and science education. The following questions serve as a guide for facilitating this type of discussion. Of course, these questions are only a starting point—the best questions are those that reflect your community's specific needs and resources.

(1) How Do We Articulate the Importance of Math and Science Skills for Success in the Workplace and in Life?

- What academic standards pertain in our community?
- Are standards clear, specific, challenging, and reasonable?
- Do they reflect workplace skills required by employers in our community?
- Do they correlate with the best of other states and countries?
- What percentage of students take advanced mathematics and science?
- How do we know if our schools are doing a good job in mathematics (e.g., trigonometry, calculus, statistics) and science (e.g., chemistry and physics) instruction and Advanced Placement courses?
- How do our district schools stack up nationally and internationally in math and science achievement?
- Are our students completing school with the math and science skills necessary to succeed on the job or in further education/training?

(2) How Can We Support More Effective Teaching and Educational Leadership?

- What are entry-level requirements for incoming math and science teachers, especially with regard to their knowledge of subject matter?
- How are teachers encouraged to stay up to date and improve their knowledge and skills?
- Are teachers and principals given opportunities to experience private-sector workplaces and become more familiar with the skill and knowledge they demand?
- Is high quality professional development funding protected during budget crunches?
- Can business management expertise be useful to the school system—for example, through training principals or helping develop quality programs?

(3) Do Students Have the Opportunity to Learn About Workplace Skill Requirements Firsthand?

- Is textbook and software instruction accompanied by application of math and science to "real world" problems?
- Do students have the opportunity to observe examples of math and science being applied in the workplace?

(4) Do We Support the Use of Student and System Performance Data That Are Clear, Reliable, and Broadly Disseminated?

- Are student assessments aligned with challenging academic standards?
- Are assessment results benchmarked against successful schools and districts?
- Do assessments measure what's actually being taught?
- Do assessments measure both essential knowledge and critical skills such as problem-solving and analytical abilities?
- Are data on student performance tracked over time?
- Does the district periodically survey its "customers"—parents, colleges, local businesses—to determine their level of satisfaction?
- Apart from school officials, who sees test data—Parents? Policymakers? Is the information presented in understandable formats?
- Are businesses able to interpret the results—for example, in considering student transcripts during the hiring process?
- Are data on school-system performance used to guide budget decisions?
- What other kinds of information ought to be considered in making decisions about budgets, teacher recruitment, and resource allocations?
- Are data used to identify strengths and opportunities to improve curriculum, instruction, and professional development?

(5) Do We Use Student Achievement in Hiring Decisions To Send the Message to All Students That Academic Achievement is Important?

- Do local businesses ask for school records when hiring current students for part-time work?
- Do local businesses ask for school records when hiring entry-level full-time employees?
- Do local businesses give preferential hiring treatment to students who take part in school- to-work programs?
- Are local businesses working with schools to create meaningful school records?

(6) Do We Encourage Parent and Community Involvement in Schools?

- Are employees encouraged to volunteer in local schools through flexible time or leave policies?
- Do employers invite lead teachers and principals to address employees about needs in the local schools?
- How can local employers use their business expertise to help principals improve operations such as fund-raising, facilities management, staffing, technology integration?
- Do schools welcome parental involvement in all aspects of the educational process?
- Are parent conferences, open houses, and other school events scheduled during hours which are convenient for working parents?
- Do schools use technology, such as interactive voice-mail, to facilitate regular, on-going parent-teacher communication?
- Do schools provide interpreters for conferences and meetings when English is not the language spoken at home?
- Have local companies developed schools on their grounds for children of employees?

RESOURCES

Third International Mathematics and Science Study (TIMSS)

For information about TIMSS, see the TIMSS web page located at the U.S. Department of Education's site (www.ed.gov/NCES/timss) or call 1-800-USA-LEARN.

Many organizations are focusing on improving math and science achievement. Several of these listed below offer materials aimed at supporting student performance, particularly in math and science.

Achieve, Inc.: A Resource Center on Standards, Assessment, Accountability, and Technology for Governors

The mission of Achieve, Inc. is to assist governors and business leaders in their efforts to improve student achievement to world-class levels through the development and implementation of high academic standards, assessments, and accountability systems and the effective use of technology to achieve standards.

Achieve, Inc.
1280 Massachusetts Avenue
Suite 410
Cambridge, MA 02138
Telephone: 617-496-6300
Web Site: http://www.achieve.org

American Association for the Advancement of Science (AAAS) Project 2061

The American Association for the Advancement of Science (AAAS) initiated Project 2061 in 1985 to guide reform of K–12 education in science, mathematics, and technology. Project 2061 has worked with scientists and educators to define science literacy and related learning goals, along with developing a set of tools to lead the reform of the teaching and learning of science.

American Association for the
Advancement of Science
Project 2061
1331 H Street NW
PO Box 34446
Washington, DC 20005
Telephone: 202-326-6666
Web Site:
http://www.project2061@aaas.org

Business Coalition for Education Reform (BCER)

The BCER, a coalition founded and managed by the National Alliance of Business, is comprised of 13 national business-led organizations working in partnership with 350 state and local education organizations to improve academic achievement for all students by supporting and expanding business involvement in education at the national, state, and local levels. The BCER supports efforts to: (1) raise academic standards for all students; (2) ensure standards reflect the knowledge and skills needed for workplace success; and (3) help the public understand the critical need for world-class academic standards and necessary changes needed for school systems to deliver them.

Members include: *American Business Conference, The Business Roundtable, Business-Higher Education Forum, Chamber of Commerce of the United States, Committee for Economic Development, The Conference Board, Council on Competitiveness, The Council of Growing Companies, National Alliance of Business, National Association of Manufacturers, National Association of Women Business Owners, U.S. Hispanic Chamber of Commerce, Utility Business Education Coalition.*

Business Coalition for Education Reform
c/o National Alliance of Business
1201 New York Avenue NW
Suite 700
Washington, DC 20005
Telephone: 800-787-2848
Web Site: http://www.bcer.org

Education Excellence Partnership

The Education Excellence Partnership (EEP), a unique coalition of public officials, business, and teacher organizations, is working to strengthen the academic future of America's children by encouraging parents and concerned citizens to get more involved

in children's education and learn about and support higher academic standards. A series of ads distributed by the Ad Council encourages viewers to call a toll-free number to receive a free copy of the booklet, "Strengthening Your Child's Academic Future." This booklet provides sample questions parents can use to begin a dialogue with their children's teachers and administrators about the academic standards in place at their school. The EEP is a joint endeavor of The Business Roundtable, National Alliance of Business, U.S. Chamber of Commerce, U.S. Department of Education, American Federation of Teachers, National Education Association, National Governors' Association, and Achieve.

Education Excellence Partnership
c/o National Alliance of Business
attn: Karen Larson
1201 New York Avenue NW
Suite 700
Washington, DC 20005
Telephone: 800-787-2848
Web Site: http://www.brtable.org

Learning First Alliance

Twelve leading national educational organizations came together to form the Learning First Alliance, a permanent collaboration of the organizations who will work together within this newly incorporated framework to improve student learning in America's elementary and secondary public schools. The Learning First Alliance will serve as a catalyst to coordinate resources and initiatives of its member organizations to further student achievement. The Alliance will work with and through its member organizations on three specific objectives: to ensure that high academic expectations are held for all students; to ensure a positive and supportive place of learning for all students; and to engage parents and all community members in helping students achieve high academic expectations. The first major activity of the Alliance was the Learning First Alliance Summit on Reading and Math held in Washington, D.C. in early 1998.

Members include: *American Association of Colleges for Teacher Education, American Association of School Administrators, American Federation of Teachers, Council of Chief State School Officers, Education Commission of the States, National Association of State Boards of Education, National Association of Elementary School Principals, National Association of Secondary School Principals, National School Boards Association, National PTA, and National Education Association*

Learning First Alliance
1001 Connecticut Avenue NW
Suite 310
Washington, DC 20036
Telephone: 202-822-8405, ext 40
Web Site: http://www.learningfirst.org

National Academy of Sciences (NAS)

The National Academy of Sciences is a private, non-profit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters.

National Academy of Sciences
2101 Constitution Avenue NW
Washington, DC 20418
Telephone: 202-334-2000
Web Site: http://www.nas.org

National Action Council for Minorities in Engineering, Inc. (NACME)

National Action Council for Minorities in Engineering, Inc. (NACME) has led the national effort to increase access to engineering and other science-based careers. Supported by America's technology-intensive companies, NACME conducts research and public policy analysis, develops and operates national demonstration programs at precollege and university levels, and disseminates information through publications, conferences, and electronic media.

National Action Council for Minorities
in Engineering, Inc.
Empire State Building
350 Fifth Avenue, Suite 2212
New York, NY 10118-2299
Telephone: 212-279-2626
Web Site: http://www.nacme.org

National Alliance of Business (NAB)

The National Alliance of Business (NAB) advances business leadership at the local, state, and national levels to improve the quality of education and learning in schools, and in the workplace, thereby meeting the needs of employers, employees, and jobseekers. NAB's agenda is driven by three primary goals: (1) to increase the academic achievement of every American child; (2) to ensure that people make a successful transition from formal schooling to the workplace; and (3) to expand learning opportunities over a lifetime to ensure quality career opportunities for entry-level, incumbent, dislocated, and unemployed workers.

National Alliance of Business
1201 New York Avenue NW
Suite 700
Washington, DC 20005
Telephone: 800-787-2848
Web Site: http://www.nab.com

National Alliance of State Science & Mathematics Coalitions (NASSMC)

The National Alliance of State Science & Mathematics Coalitions is a nonprofit organization based in Washington, DC, with member coalitions in 40 states. It serves as the national voice of its member coalitions and as the national advocate for their state-by-state efforts to implement system-wide improvement of mathematics, science, and technology education.

National Alliance of State Science &
Mathematics Coalitions
11 Dupont Circle NW
Suite 250
Washington, DC 20036
Telephone: 202-387-3600
Web Site: http://www.nassmc.org

National Education Goals Panel (NEGP)

Eight National Goals have been established for the nation as a framework for education reform. As part of this effort, the National Education Goals Panel (NEGP) was created in 1990 to measure the nation's progress toward reaching these goals. The NEGP Web site offers a variety of resources on the Goals, the nation's and each state's progress toward them, key issues in the area of education reform, events and programs. The site displays tables and charts changes in a variety of indicators since the Goals were adopted.

National Education Goals Panel
1255 22nd Street NW
Suite 502
Washington, DC 20037-7590
202-724-0015
Web Site: http://www.negp.gov

National Science Foundation (NSF)

The National Science Foundation is an independent U.S. government agency responsible for promoting science and engineering through programs that invest over $3.3 billion per year in almost 20,000 research and education projects. It does this through grants, contracts, and cooperative agreements to more than 2,000 colleges, universities, and other research and education institutions in all parts of the United States. The Directorate for Education and Human Resources (EHR) has primary responsibility for NSF's efforts to provide national leadership in improving science, mathematics, engineering, and technology education. Its comprehensive and coordinated programs address every education level, including faculty early career development and science literacy in the general public.

National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
Telephone: 703-306-1234
Web Site: http://www.nsf.gov

National Council of Teachers of Mathematics (NCTM)

The National Council of Teachers of Mathematics (NCTM), with more than 110,000 members, is the largest nonprofit professional association of mathematics educators in the world. NCTM offers vision, leadership, and avenues of communication for mathematics educators at the elementary school, middle school, high school, and college and university levels. NCTM provides professional development opportunities through annual, regional, and leadership conferences and publishes journals, books, videos, and software.

National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 20191-1593
Telephone: 800-220-8483,
Web Site: http://www.nctm.org

The National School-to-Work Office

The U.S. Departments of Labor and Education jointly administer The School-to-Work Opportunities Act of 1994. Joint administration of the Act is carried out by the National School-to-Work Office. The National Office has established the National School-to-Work Learning and Information Center. The Center provides information, assistance, and training to build School-to-Work opportunities in the United States. The Center utilizes the latest information technology to help increase the capacity of professionals, and to develop and implement School-to-Work systems across the nation. Its services include: a resource bank of select technical assistance providers; an 800-number "Answer Line"; an Internet Home Page/Information network; databases on key STW contacts, organizations, and practices; relevant publications; and meetings, conferences, and training sessions, are available to state and local School-to-Work offices, employers, schools, labor, parents, and to the general public.

National School-to-Work Learning and Information Center
400 Virginia Avenue, SW
Room 210
Washington, DC 20024
Telephone: 800-251-7236,
Web Site: http://www.stw.ed.gov

United States Department of Education

The U.S. Department of Education's homepage features an overview of Department and Administration programs and initiatives to improve student achievement. Of particular note are the research and tools focusing on the Secretary and President's priority to ensure "all students will master challenging mathematics, including the foundations of algebra and geometry, by the end of the eighth grade."

U.S. Department of Education
600 Independence Avenue SW
Washington, DC 20202-0498
Telephone: 800-USA-LEARN
Web Site: http://www.ed.gov

National Center for Education Statistics (NCES)

NCES, part of the U.S. Department of Education, conducts studies which cover the entire educational spectrum, providing the facts and figures needed to help policymakers understand the condition of education in the nation today, to give researchers a foundation of data to build upon, and to help teachers and administrators decide on best practices for their schools. NCES oversees the TIMSS initiative.

National Center for Education Statistics
U.S. Department of Education
55 New Jersey Avenue NW
Washington, DC 20208-5574
Telephone: 202-219-1333
Web Site:
http://www.ed.gov/NCES/timss

The Partnership for Family Involvement in Education

The Partnership for Family Involvement in Education, sponsored by the U.S. Department of Education, highlights school-community-business partnerships and includes a calendar of events.

The Partnership for Family Involvement in Education
U.S. Department of Education
600 Independence Avenue SW
Washington, DC 20202-0498
Telephone: 800-USA-LEARN
Web Page: http://www.ed.gov/PFIE

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